947,147

PATENT SPECIFICATION

DRAWINGS ATTACHED

947,147

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International Classification:—F 02 f.

COMPLETE SPECIFICATION

Improvements in or relating to Valve Operating Mechanisms for use in Internal Combustion Engines

I, RALPH MILLER, a citizen of the United States of America of 1943 North Summit Avenue, Milwaukee 2, Wisconsin, United States of America, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to valve operating mechanisms for use in internal combustion engines (which term is used herein to include both 2-stroke and 4-stroke compression-ignition engines, spark-fired engines and dual-fuel engines).

The aim of the invention is to provide means by which the valve clearance or "lift" is maintained substantially constant irrespective of changes in the timing of the valve, and according to the invention valve operating mechanism for use in an internal combustion engine comprises a push-rod arranged to actuate the stem of the valve through a valve rocker arm and provided with an end surface which is engaged by a roller serving to transmit movements of a cam on the engine camshaft to the push-rod, the roller being adjustable about the axis of the cam-shaft in order to permit variations in the timing of the valve, in which the said end surface of the push-rod is of curved concave shape, the curvature of the surface being so related to its distance from the axis of the cam-shaft that adjustment of the transmission roller does not result in any alteration or only a very small alteration in the valve tappet clearance between the valve stem and the valve rocker arm.

In order that the invention may be thoroughly understood, a valve operating mechanism in accordance with it will now be described, by way of example, with reference to the drawings accompanying the Provisional Specification, in which:

Figure 1 is a diagrammatic sectional view through the cylinder of an internal combustion engine;

Figure 2 is an enlarged side view of the valve operating mechanism forming part of Figure 1; and

Figure 3 is a section taken on the line III—III in Figure 2.

The engine cylinder shown in Figure 1 has an air inlet valve 1, an exhaust valve, and a control valve 2 which is arranged upstream of the air inlet valve in or adjacent the air intake manifold 3. The time of opening and closing of the control valve 2 with respect to motion of the piston is varied with engine load by means of hydraulic actuating mechanism so as to vary the volume of the charge taken into the cylinder from the intake manifold 3.

In order that the clearance or "lift" of the control valve 2 may be maintained substantially constant when changes are made in its timing, the valve control gear includes the mechanism shown in Figures 2 and 3. This mechanism comprises a valve push-rod 21 which terminates at the bottom in a forged blade, the end surface being finished with a curved, concave, part-cylindrical surface E the centre of which coincides with the centre of the camshaft 8 when the roller 23 rests on the base circle of the cam 7. The lower end of the push-rod 21 swings on a pin or shaft 11 through a lever 9 and a pin 10. An eccentric shaft 12 carries eccentrics 6 for swinging arms 5 for both banks of a V-engine. The cylindrical surface of the push-rod 21 contacts rollers 22 mounted on each side of a cam roller 23 on a pin 13 which is carried in the swinging arm 5.

Angular displacement of the eccentric shaft 12 which carries the eccentrics 6 moves the centre of the roller 23 along the arc A—C when the roller is on the base circle of the cam 7. The rollers 22 rotating on the same

centre as the roller 23 are free to roll on the arc E, the geometry of the design being such that, as the arc E is concentric with the base circle of the cam 7, there is no longitudinal movement of the push rod 21 during adjustment of the valve timing. The pre-set tappet clearance between the upper end of the valve stem and the pivotally-mounted valve rocker arm being operated by the push rod 21 (see Figure 1) therefore remains unchanged as the opening and closing angle or timing of the valve is altered by displacing the centre of the roller 23 along the arc A—B.

It is well known that the valve tappet clearance in an engine changes with temperature, and therefore the linear expansion of such parts as the valve stems, push rods and cylinder block changes with variations in the engine load. In the usual engine construction, tappet clearance decreases as the engine components take on higher temperatures due to increase in load. The result is excessive tappet clearance and noise at light loads when the tappet clearance is adjusted to prevent valves being held open at full load and maximum engine temperatures. In some engines automatically self-adjusting, so-called "zero lash units" are used in the push rod assembly to maintain constant tappet clearance under all conditions of load and engine temperature.

From Figures 2 and 3 it will be seen that the valve operating mechanism described above can be adjusted to match the thermal characteristics of an engine so as to hold the valve tappet clearance substantially constant at all engine loads. If, for example, the no load position of the roller 23 is at or near position C and the temperature characteristics of the engine are such that the tappet clearance increases as load decreases, this can be compensated for in my valve mechanism by machining the surface E so that the centre of the arc is moved in the direction of the arrow G away from the centre of the cam 7. The surface E can also be given a curved, concave contour other than cylindrical in order to obtain uniform tappet clearance at all loads.

When the valve operating mechanism is adjusted or constructed so as to operate with uniform tappet clearance at all loads corresponding to the position of the roller 23, the stroke of the push rod 21 is equal at equal angles of the roller 23 at either side from the mid-position B. These characteristics of motion are accomplished when the centre of the arc E with the valve in its maximum lift position is on a line connecting the centres of the pin 10 and the cam 7.

Another feature of the mechanism is that the stroke of the push rod 21 or valve lift can be made to vary at any desired rate between points A and C by shifting the position of the fulcrum pin 11 which shifts the location of the centre of the arc E in the maximum stroke position.

Without any change being made in valve opening duration, the maximum valve lift can be made to occur in the full load position of the roller 23 instead of at the mid-position by adjustment of the pin 11. The change in valve lift between the full load and no load positions of roller 23 can be selected to any desired value by the amount of shift of the centre of the arc E in its open position from the line connecting the centres of the pin 10 and the cam 7 or a line parallel to it.

The invention is applicable to many different kinds of internal combustion engines, and is particularly advantageous when applied to high-pressure turbo-charged engines having an intercooler for cooling the charging air.

WHAT I CLAIM IS:—

1. Valve operating mechanism for use in internal combustion engines, comprising a push-rod arranged to actuate the stem of the valve through a valve rocker arm and provided with an end surface which is engaged by a roller serving to transmit movements of a cam on the engine cam-shaft to the push-rod, the roller being adjustable about the axis of the cam-shaft in order to permit variations in the timing of the valve, in which the said end surface of the push-rod is of curved concave shape, the curvature of the surface being so related to its distance from the axis of the cam-shaft that adjustment of the transmission roller does not result in any alteration or only a very small alteration in the valve tappet clearance between the valve stem and the valve rocker arm.

2. Valve operating mechanism according to claim 1, in which the radius of the curved surface is substantially equal to the distance between the surface and the axis of the cam-shaft.

3. Valve operating mechanism according to claim 1 or claim 2, in which the lower end of the push-rod is pivotally connected to a lever having an adjustable pivotal mounting.

4. Valve operating mechanism according to claim 2, in which the centre of radius of the curved surface lies to one side of the axis of the cam-shaft so as to compensate for changes in valve tappet clearance due to expansion of engine components with increase in temperature.

5. Valve operating mechanism substantially as described with reference to the accompanying drawing.

6. An internal combustion engine having a valve operating mechanism according to any preceding claim.

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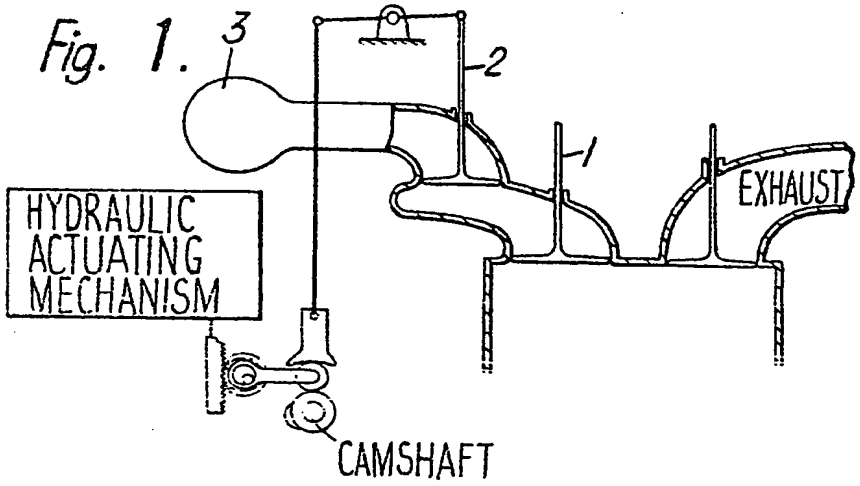
Fig. 1.



947,147 PROVISIONAL SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

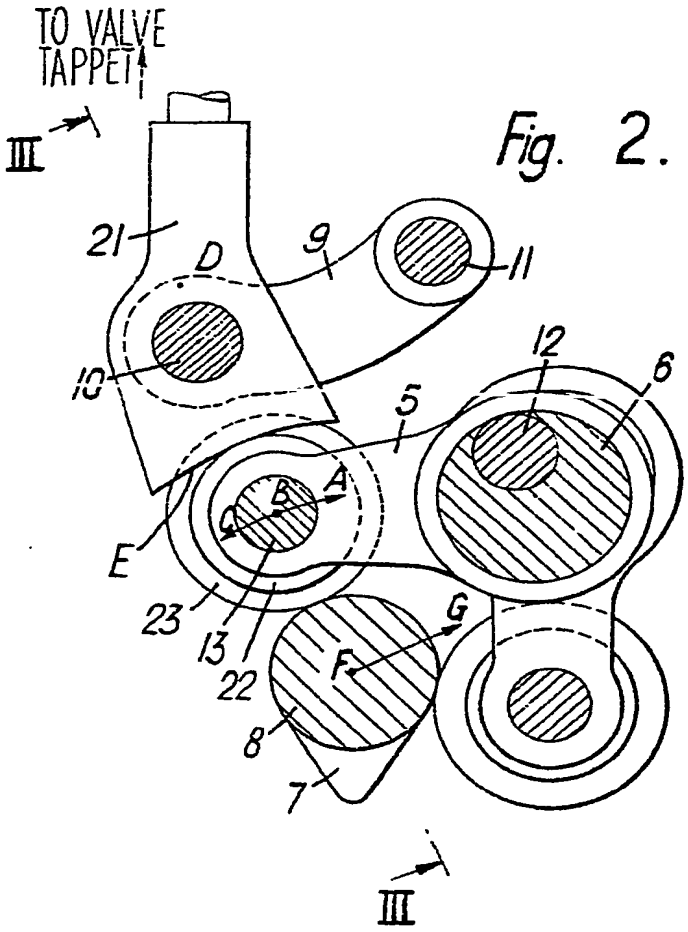


Fig. 2.

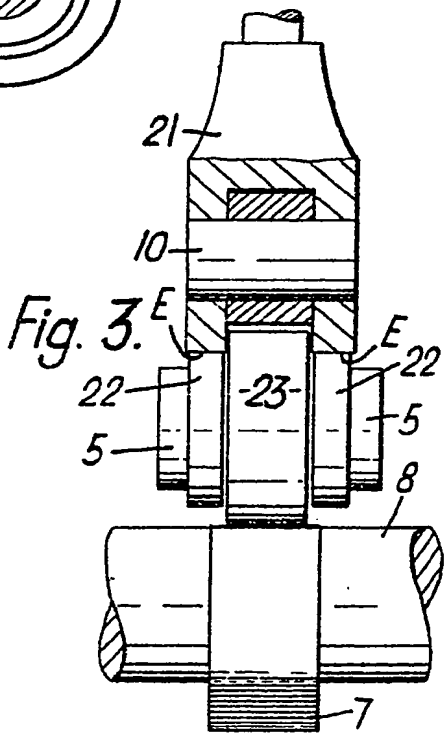


Fig. 3.

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SHEETS 1 & 2

Fig. 1.

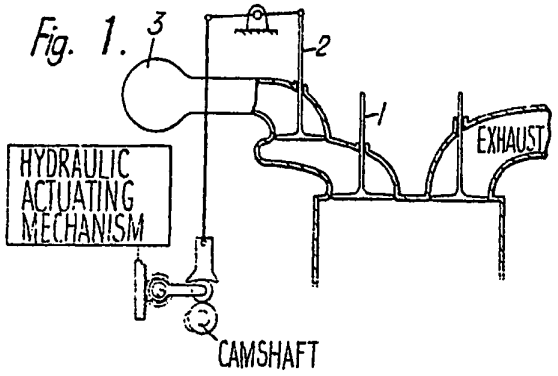

Fig. 2.

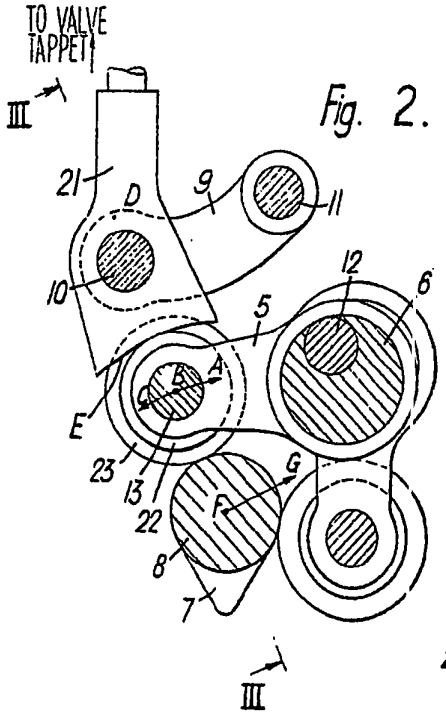

Fig. 3.